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Final Technical Note

EFFECT OF INDEXING AIDS ON THE RELIABILITY OF INDEXERS

V. Slamecka and J. Jacoby

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4833 Rugby Avenue
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Contract: AF30(602)-2616

Prepared for

Rome Air Development Center
Air Research and Technology Division
United States Air Force

Griffiss Air Force Base
New York

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ABSTRACT

The objective of ^{this report} ~~the final phase of~~ Contract AF30(602)-2616 was to determine the effect of various types of indexing aids on the minimum reliability of indexers, ~~as determined and described earlier in Technical Note RADC-TDR-62-426.~~ The three types of tools tested as indexing aids on a collection of randomly selected chemical patents were a classificatory device (Manual of Classification of the U. S. Patent Office), an alphabetical subject-authority list of terms (Chemical Patents Code List of Documentation Incorporated), and a concept-associative tool (Chemical Engineering Thesaurus of the American Institute of Chemical Engineers). The former two tools registered a highly significant improvement of the "base zero" inter-indexer consistency; the concept-association aid, on the other hand, failed to show any effect. The analyses and interpretation of the results indicate that an improvement in indexer reliability, and hence in the quality of indexing, can be brought about through the use of prescriptive, rather than suggestive, vocabularies which formalize the relationships among terms so as to invariably enjoin the indexer's assignment of index terms. Indexing aids which display numerous variable, ill-defined relationships among terms appear to be acting in the opposite direction.

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CHAPTER I

INTRODUCTION

The overall aim of the studies carried out under Contract AF30(602)-2616 is an improvement in the quality of library indexing.

In its broad sense, the phrase "quality of indexing" probably entails numerous factors ranging from the problem of the correct understanding of the subject matter in documents to the constraints inherent in individual indexing systems; for the purposes of this study, however, quality of indexing is equated with "reliability of indexing."

Reliability of indexing refers to the consistency with which indexers tend to choose the same terms as descriptive of the same documents. Inter-indexer reliability refers to the consistency among indexers; intra-indexer reliability refers to the measurement of the degree to which any one indexer tends to repeatedly choose the same index terms for the same document, with the possibility of memory of past performance influencing a given judgment accounted for and excluded.¹

The assumption that the problem of indexing quality rests, at least to an important degree, with the determination and improvement of the level of reliability of indexing, may be validated by the following illustration, in which information retrieval is presented in terms of

¹Statement of Work, Contract AF30(602)-2616.

matrix algebra.² If the union of two retrieval terms, A and B, is described as the trace of the union A and B operating on the storage matrix, and the intersection of A and B is described as the determinant of the union A and B, it is possible, in combination with the probability theory, to calculate the retrieval probability of documents indexed. For example: Let it be assumed that one document is indexed by three indexers, each of whom uses seven terms in such a way that the total vocabulary consists of ten indexing terms. Let there be a 50 per cent consistency between each pair of indexers, and a 40 per cent consistency among all three indexers. The probability of retrieving that document by searching under any given number of the ten terms is apparent from Figure 1. It may be seen that the probability of document retrieval, in the situation described, increases with a higher inter-indexer consistency.

The immediate objective of the present contract was to determine the amount of inter- and intra-indexer consistency under two sets of conditions. Phase I of the studies sought to determine the amount of agreement attained by indexers who have had, during indexing, no recourse to look-up tools and indexing aids other than the indexing rules; Phase II has attempted to determine the effect of indexing tools on inter-indexer consistency. There has been no endeavor under this contract to study the underlying assumption (that indexing reliability affects retrieval efficiency). Phase I results were reported in two earlier Technical Notes.

²The concept was developed by Mr. Wolf Kuebler of Documentation Incorporated.

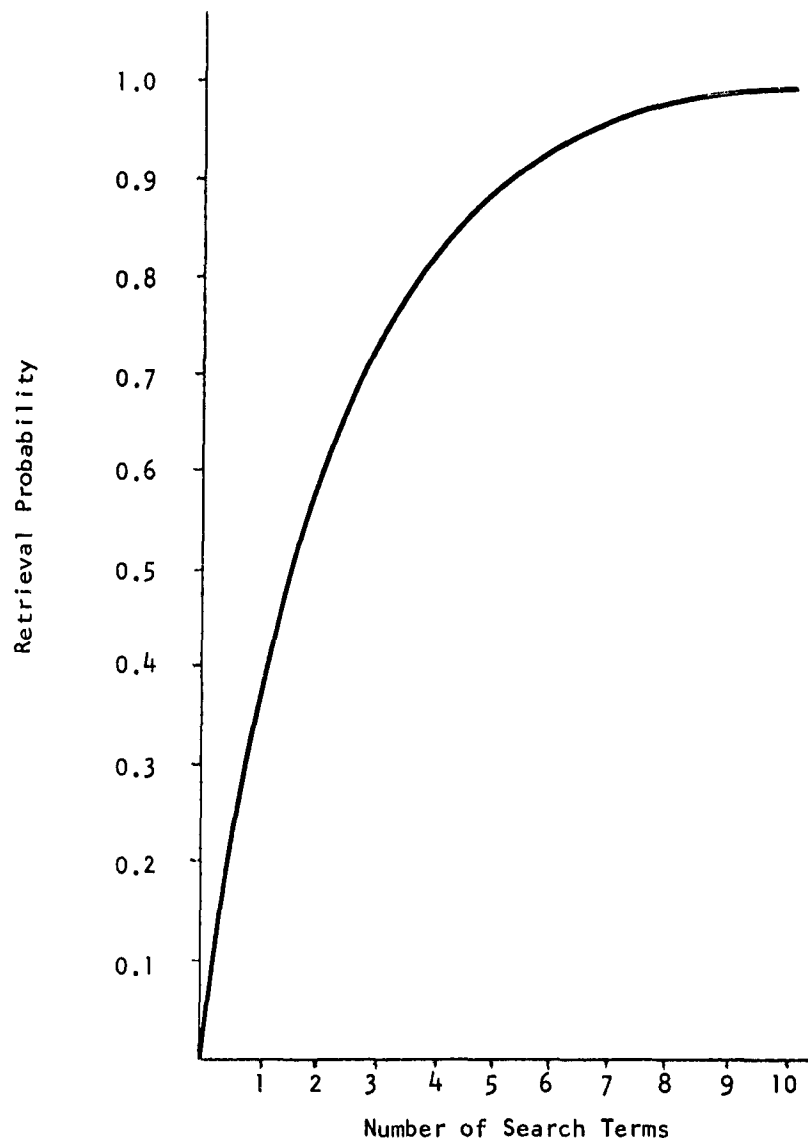


Fig. 1.--Retrieval probability curve at 40 per cent inter-indexer consistency for ten indexing terms.

The first of these³ outlined the methodology for assessing inter- and intra-indexer consistency under minimal conditions. The indexing system chosen was the Uniterm system of coordinate indexing, employed under conditions which were somewhat artificial and rigidly regulated to exclude any factors which might raise the Base Zero value. The population of documents selected for the inter-indexer consistency test was a stratified random sample of 75 chemical patents. All indexers were required to index the title and claims of each patent; the remainder of the document was indexed according to their best judgment. In this manner, a comparison was sought between the indexers' consistency in rigidly defined document areas, and that in situations allowing a freedom of indexing choice.

Special conditions were necessary for the intra-indexer reliability test to control the problem of indexer's recall, or memory. The sample of patents consisted of three batches of "equated" documents, each having 75 patents, on the assumption that the test results on one batch would equal those on any of the other two batches.

The test subjects consisted of two groups of indexers numbering three experienced and 3 beginner indexers.

The hypotheses tested in Phase I were the following: (1) there is no significant difference among the indexers in the number of terms used to describe each section of a given patent; (2) there is no significant difference among the indexers in the percentage of terms any one indexer has with any other indexer; and (3) there is no significant difference

³J. Jacoby, Methodology for indexer reliability tests, RADC-TN-62-1 (Bethesda, Md., Documentation Incorporated, March 1962).

present in the indexing of an equated patent by any one indexer in either the number of terms used or the percentage of terms used.

The measure of inter-indexer consistency was defined by two criteria: (1) the number of terms used by each indexer per document, and (2) the percentage of matched terms employed by the experienced and inexperienced indexers to index a document.

The actual results of Phase I experiments were described in the second Technical Note.⁴ They are summarized in the following paragraphs.

When the number of index terms was used as a measure for evaluation, there was found a lack of inter-indexer consistency. The experienced indexers showed less variation than their inexperienced colleagues, and a defined indexing area yielded more stability than an unbounded area. A significant difference was determined in the number of terms assigned to chemical patents by individual indexers, thus refuting the relevant hypothesis of this experiment. With regard to the percentage of terms matched, the experienced indexers have attained a significantly higher degree of inter-indexer consistency than the inexperienced indexers, with less internal variation. Both groups of indexers attained a higher degree of consistency in the bounded section of patents.

Upon integrating the results pertinent to these criteria of inter-indexer consistency, it was concluded that whereas there was a large amount of individual variation, there exists a significant difference in consistency when experienced indexers are compared to beginners. The

⁴J. Jacoby and V. Slamecka, Indexer consistency under minimal conditions, RADC-TDR-62-426 (Bethesda, Md., Documentation Incorporated, November 1962).

experienced indexers use less terms and exhibit a higher stability in their choice of terms. Furthermore, the number of terms used to index a bounded, or defined, area of documents is lesser, and the percentage of consistency higher, than when indexing an unbounded, or unspecified, area of documents.

The results of the intra-indexer reliability tests have shown that on the whole, indexers tend to be consistent when they re-index equated patents using a general term vocabulary. Inexperienced indexers tend to be more consistent upon re-indexing an equated document in the bounded section. Of particular interest was the fact that the two highest levels of consistency were attained by inexperienced indexers. Since the results of the intra-indexer consistency tests were somewhat qualified by the methodology employed, it was agreed that this particular phase of the investigations would be dropped from the Phase II studies.

The purpose of Phase II has been to investigate, theoretically and experimentally, the possibilities of improving indexer reliability, as determined in Phase I, through the use of various indexing aids designed to overcome the limitations of indexer memory, and to provide a feedback relative to the usefulness of indexing operations. The theoretical study was published in a Final Technical Report entitled "Indexing Aids" which analyzed classificatory schedules, alphabetical vocabularies, and concept-association lists from the viewpoint of their utility in coordinate indexing as aids prescribing invariable, and suggesting variable relationships among indexing terms.⁵

⁵V. Slamecka, Indexing aids, RADC-TDR-62-579 (Bethesda, Md., Documentation Incorporated, January 1963). See also V. Slamecka, "Classificatory, Alphabetical, and Associative Schedules as Aids in Coordinate Indexing," American Documentation, Vol. 14, No. 3 (July 1963).

With a view toward selecting indexing aids for testing in the experimental Phase II, the following observations were tentatively drawn in this Report:

(1) Hierarchical classification schedules, including faceted schedules, are helpful to the indexer in his analysis of subject matter. The rigidity of hierarchical approach renders them only partially useful as aids in coordinate indexing; by the same token, however, they appear conducive to greater indexer reliability.

(2) Alphabetical lists of terms usually contain only a limited number of cross references among terms. When compiled from the terms freely used by indexers, they can become useful guides to indexers only after they have been carefully edited; and when provided with cross references for the invariable relations among terms, they may serve as indexing authorities, and thus be conducive to improved indexer consistency.

(3) Concept-association lists differ from alphabetical lists in that they also display, in addition to the invariable relations among terms, a great number of variable relationships of all types. The numerous displays of variable relationships increase the range of the indexer's choice of terms by suggesting to him additional possible indexing terms; as a result, concept-association displays are unlikely to improve the consistency of indexing.

The Final Technical Report concluded that indexing aids which prescribe to the indexer the invariable term selections are conducive to better indexer consistency; on the other hand, the higher in a tool the number of variable cross references which can be employed by indexers only as suggestions, the lower the probable value of these tools for

improvement of indexing consistency. The Report also outlined the methodology for an experimental investigation in which the effect of indexing aids on indexer reliability would be studied. This methodology, and the ensuing experimental results, are summarized in Chapter II.

CHAPTER II

THE EFFECT OF INDEXING AIDS ON INTER-INDEXER CONSISTENCY: EXPERIMENTAL RESULTS

The indexing aids tested in Phase II were selected on the basis of their availability, their applicability to the document collection (chemical patents) and to the system of indexing (Uniterm system of coordinate indexing), by economic considerations, and by the preceding theoretical analysis in Final Technical Report RADG-TDR-62-579. Drawn from the alphabetical, associated, and hierarchical types of indexing aids, the tools selected were, respectively, the Chemical Patents Code Manual of Documentation Incorporated (hereafter referred to as the Vocabulary), the Chemical Engineering Thesaurus of the American Institute of Chemical Engineers, and the Manual of Classification of the United States Patent Office. Following a brief outline of the methodology employed, the results of Phase II experiments are noted and compared to the results of the Base Zero test, and the amount of change in inter-indexer reliability evaluated.

Methodology

Each of the three tests, using one of the three indexing aids named above, consisted of indexing of 25 chemical patents selected randomly to eliminate bias due to subject matter and degree of complexity. The indexing instructions (see Appendix III) required each of the three experienced indexers to index the documents to the best of his ability,

noting separately the terms chosen for the bounded and unbounded sections, and utilizing simultaneously or subsequently one of the three indexing tools to withdraw or complement his selection of indexing terms. Each such change in the selection of terms caused by his consulting of the aid was to be noted by the indexer.

The independent variables evaluated are: (1) the Indexers, (2) the sections of the patent, and (3) the patents. The dependent variables, which measure the amount of reliability of consistency, are: (1) the number of terms used, and (2) the percentage of terms matched between any two indexers. The hypotheses are given with the results of these individual tests.

A special analysis was proposed for the "term origin" for each tool, as indicated by indexers in the following five categories: (1) original term found in indexing aid and retained; (2) original term not found in indexing aid but retained; (3) original term rejected upon inspection of the aid, whether found or not, and no new term substituted; (4) original term rejected upon inspection of the aid, and a new term substituted; and (5) term suggested by and adopted from the indexing aid. The analysis of these categories hoped to determine quantitatively the nature of the effect of each indexing tool on indexer consistency (that is, which of the categories had the most pronounced effect); as will be shown, the results are not complete because two of the three indexers failed to indicate properly the respective categories they used.

Number of Terms Used

As a measurement of the relative effect of each indexing aid on the volume of indexing, the number of terms used to index each patent

was analyzed. It was hoped that if these indexing aids generated substantially different amounts of terms, some conclusions could be drawn concerning their quantitative characteristics. Yet it must be noted that as a single measure of indexer consistency, the number of terms is not a proper criterion; rather, it is a quantitative indication of the volume of indexing which is generated by the use of these aids.

Three hypotheses were tested:

(1) There is no significant difference among indexers, patent sections, and patents with respect to the number of terms used to index a document;

(2) There is no significant difference between the test results of indexing under minimal conditions (hereafter referred to as the Base Zero Test) and the results recorded by the use of any given indexing tool;

(3) There is no significant difference in the test results recorded by all indexing tools.

Results

Tables 1-3 indicate the significant variables which resulted from the analyses of variance (see Appendix II) of the three indexing aids and the Base Zero Test. Table 4 summarizes the results obtained by the Indexers under each test condition.

The following main points summarize the results obtained in these analyses:

TABLE 1
NUMBER OF TERMS USED: SIGNIFICANT VARIABLES
ACTING WITHIN EACH INDEXING AID

Item	Base Zero	Thesaurus	Vocabulary	Patent Office Classification
Indexers	X	-	-	-
Sections	X	X	X	X
Patents	X	X	-	-
Indexer/Sections	-	X	X	X
Indexer/Patents	-	X	X	-
Section/Patents	X	X	X	X

TABLE 2
NUMBER OF TERMS USED: SIGNIFICANT VARIABLES
FROM COMPARISON OF EACH INDEXING AID
WITH BASE ZERO TEST

Item	Thesaurus	Vocabulary	Patent Office Classification
Aid/Patents	-	-	X
Aid/Indexer/Sections	X	X	X
Aid/Section/Patents	X	-	X

TABLE 3
NUMBER OF TERMS USED: SIGNIFICANT VARIABLES
FROM COMPARISON OF INDEXING AIDS

Aid/Indexers
Aid/Patents
Aid/Indexers/Patents
Aid/Section/Patents

TABLE 4

NUMBER OF TERMS USED: RESULTS OF TESTS, AND SUMMARY

Item	Base Zero	Thesaurus	Vocabulary	Patent Office Classification
Avg. no. terms used by indexers per patent	37.8	46.4	50.5	43.4
Avg. no. terms used by indexers per section				
Bounded	13.4	18.7	19.3	16.1
Unbounded	24.4	27.7	31.2	27.3
Avg. no. terms used per indexer				
Indexer 1	34.3	56.5	56.5	47.4
Indexer 2	34.8	36.3	38.2	35.7
Indexer 3	44.2	46.3	56.8	47.1
Avg. no. terms used per indexer per section				
Bounded				
Indexer 1	11.1	25.6	24.6	19.1
Indexer 2	12.1	13.7	13.3	12.9
Indexer 3	16.9	16.8	19.8	16.5
Unbounded				
Indexer 1	23.2	30.9	31.9	28.4
Indexer 2	22.6	22.6	24.8	22.8
Indexer 3	27.3	29.5	36.9	30.6
Avg. variation between patents for each indexer (standard deviations)				
Indexer 1	10.1	13.2	15.2	17.8
Indexer 2	7.7	9.8	10.2	10.4
Indexer 3	9.3	12.4	19.9	16.2
Avg. variation between patents per section (standard deviations)				
Bounded	7.3	10.5	20.0	20.1
Unbounded	8.9	12.8	24.5	28.9
Avg. variation between patents per tool (standard deviations) . . .	28.2	47.9	39.4	40.3

(1) Table 4 shows that the largest average number of terms used to index a patent was generated by the use of the Vocabulary, and the smallest in the Base Zero Test. The differences between the test conditions are, however, not substantial enough to be statistically significant.

(2) Of significance is the fact that with all the indexing aids tested, about 62 per cent of the terms used per patent were allocated to the unbounded section of the patent. Not only were more terms used in this section, but a greater range in the number of terms used for this section was noted by the larger amount of variation present.

(3) Only the Thesaurus yielded a wide variation in the volume of indexing per patent regardless of section. All other tools showed no such great variability because of the canceling effect of the relative consistency in the bounded section of the patents. When these aids were compared to the Base Zero Test, however, only the Patent Office Classification list differed substantially from the amount of variation among patents present under this minimal condition. When these aids were compared to each other, on the other hand, they all differed significantly, the most variable being the Thesaurus, the least the Vocabulary.

(4) Indexer consistency under each test condition was, on the average, good, although differences were noted between the indexing aids. The trend was as follows: all indexers used the highest number of terms per patent when using the Vocabulary, the second largest number of terms with the Thesaurus, and the third with the Patent Office Classification manual. All indexers tended to be more variable in the range of the number of terms they used in the unbounded section than that in the bounded section. Finally, the Vocabulary and Patent Office

Classification list were the only two aids which resulted in the same ranking of indexers in both sections: Indexer 1 using the largest number of terms, Indexer 2 using the fewest terms.

(5) The standard deviation from the average number of terms used by each indexer indicates the amount of variation he used in assigning terms to each of the patents. The results of this examination show that the indexer who used the largest number of terms per patent also tended to be most variable in the range of these terms, except in the Base Zero Test, and that he tended to be more variable in the unbounded section than in the bounded.

Conclusions

The conclusions which can be drawn from this phase of the test concern the differences in the quantitative characteristics generated by the three types of indexing aids.

(1) The Thesaurus, the aid with the highest number of suggestive cross references, generated slightly less terms than the Vocabulary. The lowest number of terms generated by the Patent Office Classification manual does not represent a significant decrease over the other tools.

(2) There is generally good indexer consistency within each indexing aid, although when the aids are compared there is a definite difference between them with regard to the number of terms used by an indexer; the more terms used, the greater the variability.

(3) The largest and most striking difference which occurs within each aid and in comparison to each other is that between the bounded and the unbounded sections. It appears that if the section to be indexed is clearly defined, fewer terms are used by the indexers, regardless of indexing aid, and less variability is encountered in the number of terms

used per patent.

(4) The patents vary in length, and so does the number of terms deemed necessary by the indexer to describe them. Again, where the largest number of terms is the standard, so is the amount of variation from patent to patent.

In general, when the tools are compared, there was less variability in the number of terms used in the Base Zero Test and the Thesaurus, but as a rule a higher consistency of trend with the Vocabulary and the Patent Office Classification manual.

Percentage of Terms Matched

The criterion of evaluation here was the percentage of terms matched between pairs of indexers. The primary purpose of this part of the investigation was to attempt to ascertain whether any differences in the percentage of terms matched by these indexers could be attributed to the indexing tool they utilized. The secondary aim, also included in this section, was the measurement of the differences which occurred between matches in different types of indexed areas--those which were specified and those in which the indexer was allowed to choose which item he desired to index. Also, a test was made to discover whether any of these indexing aids led to greater consistency among the indexers. All three aids were compared to the Base Zero Test to note any differences.

In the Base Zero Test, the differences compared were between two groups of indexers, the experienced and the inexperienced. In Phase II, where there no longer existed an inexperienced group, the differences examined were those between pairs of indexers. This does not invalidate the conclusions in Phase I, since there was no significant difference

between the Indexer pairs with respect to the percentage of terms matched (and hence the experienced Indexers could be treated in Phase I as a homogeneous group). The Phase II tabulations for the Base Zero Test thus amplify those of Phase I.

The following three hypotheses were tested:

(1) There is no significant difference between Indexers, patent sections, and patents with respect to the percentage of terms matched between the indexers;

(2) There is no significant difference between the test results of indexing under minimal conditions and the results recorded by the use of any given indexing tool;

(3) There is no significant difference in the test results recorded by all indexing tools.

Results

A summary of the significant variables as determined by analysis of variance techniques (see Appendix II) is presented in Tables 5-7, followed by a summary of the results in Table 8.

TABLE 5

PERCENTAGE OF TERMS MATCHED: SIGNIFICANT VARIABLES
ACTING WITHIN EACH INDEXING AID

Item	Base Zero	Thesaurus	Vocabulary	Patent Office Classification
Indexers	-	-	X	X
Sections	-	-	X	X
Patents	-	X	-	-
Indexer/Section	X	X	-	-
Indexer/Patents	X	X	X	X
Section/Patents	-	-	X	X

TABLE 6
 PERCENTAGE OF TERMS MATCHED: SIGNIFICANT VARIABLES
 FROM COMPARISON OF EACH INDEXING AID
 WITH BASE ZERO TEST

Item	Thesaurus	Vocabulary	Patent Office Classification
Test Conditions (TC)	-	X	X
TC/Section	-	X	X
TC/Indexer/Patents	-	X	X
TC/Section/Patents	-	X	X

TABLE 7
 PERCENTAGE OF TERMS MATCHED: SIGNIFICANT VARIABLES
 FROM COMPARISON OF INDEXING AIDS

Test Conditions (TC)
 TC/Sections
 TC/Indexers/Patents
 TC/Sections/Patents

TABLE 8
PERCENTAGE OF TERMS MATCHED: RESULTS OF TESTS, AND SUMMARY

Item	Base Zero	Thesaurus	Vocabulary	Patent Office Classification
Avg. % terms matched per patent section by any pair of indexers				
Bounded	9.5	8.2	41.2	40.6
Unbounded	8.8	8.4	35.2	34.3
Avg. % terms matched between indexer pairs per section				
Bounded				
Indexers 1 - 2	3.0	4.4	33.1	38.1
Indexers 1 - 3	12.8	10.5	43.8	37.9
Indexers 2 - 3	12.9	9.6	46.9	45.8
Unbounded				
Indexers 1 - 2	5.7	4.5	30.5	29.8
Indexers 1 - 3	5.9	8.4	35.5	31.6
Indexers 2 - 3	14.7	12.5	39.7	41.6
Standard deviation in patents for each pair of indexers				
Indexers 1 - 2	6.5	4.0	18.8	18.8
Indexers 1 - 3	13.3	6.1	20.0	17.6
Indexers 2 - 3	6.6	6.1	18.4	25.1
Standard deviation in patents per section				
Bounded	13.0	6.2	30.0	29.6
Unbounded	6.3	6.2	18.2	26.8
Standard deviation in patents per tool	15.5	16.0	12.5	14.6

Note: No analysis was performed to ascertain the average number of terms matched per patent. Since identical terms sometimes occur in both sections of a given patent, it is not possible to take the arithmetic mean of the sections as the average number of terms matched per patent.

(1) Table 8 shows that a striking increase in the percentage of terms matched between any two indexers in either patent section occurred with the use of the Vocabulary and Patent Office Classification list. From an average of about 8 or 9 per cent of matching terms in each section of the Base Zero Test and with the use of a Thesaurus, the percentage of matching terms increased with the utilization of the other two aids to about 38 per cent.

(2) Of equal importance is the fact that the Thesaurus, as an aid to indexers, shows no significant differences in any of the variables examined when compared to the Base Zero Test; rather, it is remarkably similar to the latter (cf. Table 6).

(3) As was true in the Base Zero Test and with all the indexing aids tested, a larger or equal percentage of matching terms was recorded in the bounded (specified) section of the patent than in the unbounded section. The variation in the range of percentages was smaller when the Vocabulary and the Patent Office Classification aids were used; this was not the case with the Base Zero and Thesaurus tests.

(4) Even though the Vocabulary and Patent Office Classification aids showed the highest percentages of matching terms, they were the only two aids which also showed significant differences between the indexer pairs. In other words, only with these aids was there, on the average, substantial indexer inconsistency. The Vocabulary and Patent Office Classification aids also showed the largest variation in the range of the percentage of terms matching per patent between indexers and patent sections.

Conclusions

The experiment established that the alphabetical and hierarchical indexing aids record a significant increase in the percentage of matched terms. The associative tool, on the other hand, has failed to improve the consistency level of the Base Zero Test.

Term Origin Analysis

In Phase II, the indexers were asked to label the source or treatment of each term used to index a patent. Five classifications of "term origin" were established, in an attempt to determine the role of the indexing aid, and to measure the amount of uncertainty or indecision on the part of the indexer. These five categories of term origin classification were: (1) original term found in indexing aid and retained; (2) original term not found in indexing aid but retained; (3) original term rejected upon inspection of the aid, whether found or not, and no new term substituted; (4) original term rejected upon inspection of the aid, and a new term substituted; and (5) term suggested by, and adopted from the indexing aid.

Certain limitations to this part of the Phase II program became apparent after the analysis of the results. First, the indexers failed to record a "term origin" classification for some of the terms chosen (and hence the term totals in Table 9 differ from the totals of terms used in Appendices I-4, I-5, and I-6). Second, the distributions among the categories in Table 9 showed that Indexer 1 was in wide variance with the distributions for the other two indexers. In a post-experimental interview, Indexers 2 and 3 stated that they did not fully understand the instructions for the term origin phase, even though they stated that

they had prior to the administration of the test. It is the feeling of the authors that the psychological action of affirming indecision, as exemplified by categories 3-5, was powerful enough to preclude an objective categorization of term origins by these two indexers. Hence, the results and conclusions stated in the following pages must be interpreted in the light of these findings.

Results

The results of the distribution of the number of terms by origin, indexer, and indexing aid are presented in Table 9.

TABLE 9
DISTRIBUTION OF THE ORIGIN OF TERMS BY
INDEXING AID AND INDEXER

Term Origin	Thesaurus			Vocabulary			Patent Office		
	Indexer			Indexer			Indexer		
	1	2	3	1	2	3	1	2	3
1. Original term found and retained	638	415	577	658	562	831	345	313	432
2. Original term not found but retained	117	161	179	2	0	2	284	298	367
3. Original term rejected, no new term used	59	1	0	2	1	0	42	0	0
4. Original term rejected, new term used	51	3	0	83	8	0	73	0	1
5. New term suggested and adopted by aid	44	7	0	15	1	0	6	2	0

they had prior to the administration of the test. It is the feeling of the authors that the psychological action of affirming indecision, as exemplified by categories 3-5, was powerful enough to preclude an objective categorization of term origins by these two indexers. Hence, the results and conclusions stated in the following pages must be interpreted in the light of these findings.

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4. Original term rejected, new term used	51	3	0	83	8	0	73	0	1
5. New term suggested and adopted by aid	44	7	0	15	1	0	6	2	0

This table illustrates the great discrepancy which exists between Indexer 1 and the other two indexers. While it is not experimentally proper to eliminate two test subjects because they did not produce the expected results, neither can Indexer 1 be eliminated. If Indexers 2 and 3 are considered representative, the results show that they overwhelmingly exhibited no indecision, as represented by categories 3-5, but relied upon their original choice of an indexing term as the final one. Only with the vocabulary indexing tool did they exclude their original terms if the latter were not located in that aid. It is felt that this is due to the fact that they were more familiar with the vocabulary listing and hence placed more faith in its ability to affirm or deny their original selection of a term.

When, however, Indexer 1 is considered truly representative of the influence of tools upon decisions to accept or reject a term, or even to suggest a new term, then an entirely different analysis of these tools is possible. We feel strongly that this was the case, hence the analysis of this distribution is considered more fully below. However, it must be borne in mind that the following conclusions are based upon one indexer's reactions and not the majority's:

(1) There is a rather large variation in Category 1--the original term found and retained among indexing aids. The Vocabulary rates highest; the Thesaurus presented more difficulty in the indexer's location of a term, and there was even more difficulty with the Patent Office Classification manual. Both of these latter tools show the second largest percentage of terms being characterized by the indexer as 'original term not found but retained.'

(2) In relatively few cases, the original term was rejected and

no new term substituted for it; this happened more frequently with the Thesaurus and the Patent Office Classification manual than with the Vocabulary. If only Indexer 1 is taken to indicate the trend, this conclusion is more apparent: he rejected almost 7 per cent of his terms with the Thesaurus, about 6 per cent with the Patent Office Classification manual, and only 0.3 per cent with the Vocabulary.

(3) The substitution of a new term for a rejected term occurred more frequently with the Vocabulary list (and the Patent Office Classification manual) than with the Thesaurus which presented more references to the indexer. Again, looking at Indexer 1, we see that he substituted almost 11 per cent of the terms with the Vocabulary, almost 10 per cent with the Patent Office Classification manual, and only 6 per cent with the Thesaurus.

(4) The Thesaurus comes to the fore with regard to the percentage of terms suggested by the indexing aid, with Indexer 1 adopting almost 5 per cent of his terms, as compared to his adoption rates of 2 per cent and 0.8 per cent with the Vocabulary and Patent Office Classification lists, respectively.

Conclusions

Even with the apparent limitations arising from this type of subjective and inherently qualitative test, it appears that there is among experienced indexers a predominant trend to retain their original selections of indexing terms, whether they find them in an indexing aid or not.

However, when their tendencies toward indecision and uncertainty are evaluated, there are variations which can be attributed to the

indexing aids. The Thesaurus' strongest force seems to lie in its ability to suggest new terms to the indexer; the Vocabulary and the Patent Office Classification manual appear to be about equal in their ability to cause the indexer to reject his original term (under conditions of indecision) and substitute another one for it. At the same time, the Vocabulary is least helpful when an indexer rejects a term without finding a new one; the other two aids offer the indexer a better possibility for term substitution.

CHAPTER III

PHASE II: CONCLUSIONS AND SUMMARY

(1) With the use of indexing aids, indexers generate on the average less terms, and attain a higher inter-indexer consistency, in the bounded section of documents than in the unspecified section. This trend is in agreement with the conclusions from Phase I experiments.

(2) With respect to the reliability of indexers, Phase II tests show a significant difference between the results of unaided Base Zero indexing and those recorded with the use of two indexing aids, and in the individual effect of the aids used. While there was no significant difference in the effect on the variables examined in the Base Zero and the Thesaurus tests, the Vocabulary and the manual of Classification yielded a significantly higher inter-indexer consistency when compared with the Base Zero and the Thesaurus tests.

With regard to the three indexing aids tested, combined results of the statistical analyses support the following conclusions and their interpretation:

The alphabetical Vocabulary (the Chemical Patents Coding Manual of Documentation Incorporated) produced the highest average consistency among indexers (about 38 per cent per patent section).

This conclusion appears to reflect the inherent character of an alphabetical subject-authority list, edited for synonyms and other undesirable terms, and containing a small number of invariable ("see"

and "also post on") instructions but no variable ("see also" and "related term") cross references. The absence of variable referrals accounts for the established fact that the Vocabulary did not give indexers much opportunity for term substitution even when they decided to delete an originally selected term. The Vocabulary thus acted as a subject-term authority list, with its attendant standardizing influence on the indexing language; in this light, the fact that the tool generated the largest number of terms per patent (even though the difference from the other aids was not significant) indicates the greatest depth of subject analysis. The edited structure of the Vocabulary, and the previous experience of two indexers in using it, explain why indexers only rarely rejected an originally selected term, and why they were able to locate more terms in the Vocabulary than in the other indexing aids.

The Patent Office Manual of Classification produced the lowest number of terms per patent (although not significantly so); with its aid, the indexers attained the second highest average consistency, only slightly lower than with the Vocabulary.

These conclusions may be interpreted plausibly as follows: as a hierarchical classificatory schedule, the Manual differs from the Vocabulary in having less chemical terms (as a result of which it presented the greatest difficulty of the three tools in locating selected terms), and in providing a limited, non-prescriptive hierarchical term-selection guidance. Since this generic display of relationships is usually unidirectional, and it frequently involves only one level of hierarchy, the suggestive power of the Manual is relatively low. The classification schedule then also acts largely as an authority list, although less comprehensive than the Vocabulary; it advises the indexer

whether to retain or drop a term, and it suggests to him a small number of additional, generically related terms; in this manner, the Manual is of more help than the Vocabulary when the indexer wishes to find a replacement for an originally selected term. The fact that its display of a small number of variable generic relationships among terms did not appreciably affect the high inter-indexer consistency lends basis to the untested postulate that the display of variable generic (vertical) relationships in indexing aids is not as harmful to indexer reliability as that of the variable semantic (horizontal) relationships among terms.

The Chemical Engineering Thesaurus did not lead the indexers to use an appreciably higher number of terms than the other tools, but it did produce a significant variation in the volume of indexing per patent regardless of section. With its aid, the indexers registered the lowest inter-indexer consistency level in the whole project (about 8 per cent per patent section), slightly below that of the unaided Base Zero Test. The Thesaurus demonstrated the strongest impact in its ability to suggest new terms; at the same time, while it led to the largest number of term rejections, it was weakest in offering substitutions for the rejected terms.

An explanation of these trends may again be sought in the character of thesauri. As concept-association aids, they contain large numbers of variable ("related term," "see also") cross references which are to be employed according to each indexer's best judgment; in permitting this semantic freedom of term assignment, thesauri are the least prescriptive and authoritative indexing aids. Even though the A.I.Ch.E. Thesaurus was least helpful in offering indexers substitutions for rejected terms (which indecision may be a result of the indexers' lack of familiarity

with the tool as well as a characteristic inherent in it), the probable net result of their term replacements was the introduction of a greater variety of terms, and hence a greater inter-indexer inconsistency. The Manual of Classification and the Vocabulary, on the other hand, which were responsible for more term substitutions, usually presented the indexers with a single possibility of term replacement, so that the final effect was one of vocabulary standardization.

Phase II experiments were not concerned with the effect of indexing aids upon intra-indexer consistency, and hence no conclusions in this respect are supported by the statistical data obtained.

CHAPTER IV

PROJECT SUMMARY AND RECOMMENDATIONS

The results of the investigations under Contract AF30(602)-2616 support two general conclusions:

(1) Reliability of indexing, with or without the use of indexing aids, is higher when experienced indexers are instructed to index a specified, bounded portion (or portions) of documents. If this conclusion also applies to classes of documents other than chemical patents, it follows that indexing from titles or abstracts, or from other defined portions of documents, is more consistent than "random" indexing from the entire document. The present study did not, however, seek to compare the adequacy of subject coverage attained by either method of indexing.

(2) Inter-indexer consistency improves significantly with the use of prescriptive indexing aids which contain a minimal display of the variable semantic relationships among terms. The use of indexing aids which enlarge the indexers' semantic freedom of term choice is detrimental to indexing reliability. These conclusions imply that greater consistency in coordinate indexing, and hence an improvement in the quality of indexing, lie in the direction of controlled indexing vocabularies which formalize the relationships of terms so as to uniformly and invariably prescribe the choice of indexing terms.

The above conclusions are valid for the conditions of the experiment,

that is, for the Uniterm system of coordinate indexing, for the document population of chemical patents, and for the group of indexers used. Assuming the validity of the interpretation of the project results in the preceding Chapter, however, they also apply to other systems of indexing and to other types of documents.

Since it was not possible in this experiment to obtain unequivocal evidence for the interpretation of the test results (cf. pp. 22-24), the authors believe that there is a need for further experimentation in a direction which would test the validity of their interpretations. Future experiments of the type reported here should also attempt to mitigate the subjective, unavoidable effect of previous experience of indexers by selecting a larger number of test subjects having a varied indexing experience and background.

Consistency among indexers is desirable on the assumption (not investigated in this project) that it improves the effectiveness of information retrieval; this assumption, in turn, is valid if the terms selected by indexers for a given document are all the terms properly descriptive of that document, and if they fully suffice to retrieve it. (Without this condition, indexers might conceivably be consistent in the selection of too few, or improper, terms, yet have no desirable effect on the effectiveness of retrieval.) The relationships between indexing consistency and effectiveness of information retrieval appears to us to be a valid topic for future investigation.

Supposing, further, that optimum (100 per cent) reliability is not obtainable at the input (indexing) end, it is then propitious to investigate the possibility of overcoming, at least in part, the remaining disagreement among indexers in a given system of indexing at

the output (searching) end. A study of retrieval reliability, and of the effect of alphabetical, classificatory, and concept-association tools and devices (whose utility, or lack of it, may differ from that at the indexing end) may contribute further to the optimization of information storage and retrieval systems.

APPENDIX I

TEST RESULTS

NOTE: The Base Zero Test was conducted on 75 patents. In order to simplify its comparison with the 25-patent experiments of Phase II, a random sample of this size was selected from the original Base Zero Test. The sample was tested for significant variation from the means and variances in the original Base Zero Test. None was obtained; hence, it is considered that these 25 patents represent the same population, with the same mean and variance, as the original seventy-five.

NUMBER OF TERMS USED: BASE ZERO

Patent No.	Indexer 1		Indexer 2		Indexer 3		Total
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2	
1	16	27	9	19	15	21	107
2	9	40	14	23	25	43	154
3	18	15	16	40	22	53	164
4	2	27	2	18	4	19	72
5	19	14	10	16	18	20	97
6	11	9	10	28	8	13	79
7	6	13	4	20	8	28	79
8	16	20	19	22	19	27	123
9	11	12	10	23	19	38	113
10	6	25	9	15	14	25	94
11	13	28	22	25	23	29	140
12	21	20	18	28	28	42	157
13	11	16	9	13	17	17	83
14	4	37	14	24	15	23	117
15	20	22	13	23	18	31	127
16	6	18	12	14	17	18	85
17	17	8	14	17	17	16	89
18	7	42	11	25	12	33	130
19	10	27	8	19	16	16	96
20	7	37	21	29	24	35	153
21	16	39	20	33	19	27	154
22	14	14	7	15	17	27	94
23	9	28	15	27	22	28	129
24	6	14	8	24	17	28	97
25	2	29	9	26	8	26	100
Total	277	581	304	566	422	683	2833

NUMBER OF TERMS USED: THESAURUS

Patent No.	Indexer 1		Indexer 2		Indexer 3	
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
1	24	32	14	18	17	27
2	27	26	12	22	22	42
3	40	46	35	37	33	60
4	52	41	19	25	29	35
5	21	20	10	15	13	14
6	24	39	13	25	12	29
7	8	19	7	16	7	21
8	28	41	18	28	22	30
9	34	78	31	60	26	63
10	31	33	15	19	20	26
11	23	22	7	13	12	18
12	8	20	6	17	9	31
13	21	13	15	24	17	23
14	18	23	11	18	13	19
15	23	27	13	29	18	35
16	27	24	15	21	18	28
17	22	23	12	19	17	32
18	16	18	7	11	7	10
19	50	50	23	25	27	37
20	16	18	9	13	8	15
21	3	16	1	11	1	9
22	45	40	16	27	26	40
23	36	31	3	25	18	30
24	21	31	13	23	10	26
25	23	42	17	25	17	38
Total	641	773	342	566	419	738

NUMBER OF TERMS USED: PATENT OFFICE CLASSIFICATION

Patent No.	Indexer 1		Indexer 2		Indexer 3	
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
1	40	38	24	26	25	37
2	33	41	22	25	21	43
3	12	51	6	42	14	66
4	19	25	16	22	18	20
5	27	35	29	27	32	36
6	7	17	7	14	4	18
7	24	33	15	20	18	23
8	17	17	11	12	13	14
9	12	14	8	14	18	29
10	14	28	5	24	19	29
11	5	12	8	15	9	38
12	23	32	16	19	17	28
13	16	20	14	15	16	25
14	5	29	7	21	19	32
15	10	18	11	22	7	16
16	26	33	13	25	18	26
17	23	34	17	25	18	42
18	3	26	9	27	14	28
19	40	35	18	28	23	34
20	13	17	7	11	10	15
21	18	24	16	24	15	21
22	13	43	6	39	16	62
23	33	36	8	24	12	26
24	28	34	16	34	23	40
25	16	17	13	16	13	17
Total	477	709	322	571	412	765

NUMBER OF TERMS USED: VOCABULARY

Patent No.	Indexer 1		Indexer 2		Indexer 3	
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
1	29	36	22	30	26	46
2	18	30	8	29	17	33
3	29	30	10	18	23	34
4	31	41	17	29	27	51
5	13	19	8	23	9	38
6	42	50	22	33	32	50
7	38	43	20	25	31	92
8	33	19	11	12	24	23
9	25	26	13	22	20	37
10	9	26	8	34	10	53
11	16	25	7	23	9	25
12	31	39	19	31	23	44
13	27	32	18	32	19	28
14	26	26	15	26	21	41
15	33	33	14	17	17	20
16	12	20	6	10	11	13
17	24	26	14	17	32	36
18	30	37	11	19	22	37
19	26	31	20	30	28	35
20	21	35	15	29	20	37
21	32	36	12	28	18	33
22	19	43	11	21	14	31
23	20	29	10	23	14	19
24	26	38	18	34	22	37
25	5	27	4	26	7	31
Total	615	797	333	621	496	924

PERCENTAGE OF TERMS MATCHED: BASE ZERO

Patent No.	Indexers 1 - 2		Indexers 1 - 3		Indexers 2 - 3	
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
1	0.0	9.5	14.7	4.9	9.1	11.1
2	0.0	3.3	33.3	18.4	18.2	6.5
3	0.0	0.0	7.9	2.4	18.8	32.9
4	0.0	4.7	54.5	6.3	0.0	19.4
5	0.0	0.0	8.7	3.8	3.7	20.0
6	5.0	2.8	8.1	0.0	5.9	28.1
7	0.0	5.4	10.1	0.0	17.1	37.0
8	2.9	7.7	8.3	5.3	22.6	16.7
9	0.0	2.5	16.0	6.1	11.5	19.6
10	7.1	5.3	0.0	8.3	21.1	5.3
11	2.9	8.2	5.6	5.6	25.0	10.2
12	0.0	2.1	0.0	11.1	9.5	20.7
13	5.3	11.5	12.1	0.0	18.2	15.4
14	3.7	8.9	9.5	2.5	16.0	6.8
15	3.1	4.7	0.0	9.4	3.3	8.0
16	20.0	0.0	21.7	11.9	11.5	14.3
17	3.3	19.0	5.0	5.9	6.9	3.1
18	5.9	11.1	17.9	6.7	15.0	13.7
19	0.0	0.0	6.9	8.1	9.1	9.4
20	3.7	8.2	13.3	9.1	15.4	8.5
21	5.9	10.8	13.3	7.3	11.4	7.1
22	5.0	3.6	21.4	7.0	0.0	2.4
23	0.0	5.8	7.8	1.6	32.1	17.0
24	0.0	0.0	20.0	2.3	13.6	26.8
25	0.0	7.8	4.5	2.6	6.3	8.3

PERCENTAGE OF TERMS MATCHED: THESAURUS

Patent No.	Indexers 1 - 2		Indexers 1 - 3		Indexers 2 - 3	
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
1	12.0	14.3	28.1	25.5	3.3	2.3
2	2.6	2.1	16.7	13.3	9.7	20.8
3	5.6	3.8	5.8	9.3	7.9	6.5
4	4.4	6.5	15.7	7.0	2.1	9.1
5	0.0	2.9	3.0	3.0	21.0	16.0
6	8.8	3.2	5.9	19.3	13.6	10.2
7	0.0	0.0	0.0	5.3	7.7	12.1
8	4.5	4.5	6.4	4.4	11.1	5.5
9	1.6	5.3	5.3	8.5	18.8	18.3
10	12.2	8.3	18.6	9.3	2.9	2.3
11	0.0	0.0	12.9	8.1	11.8	19.2
12	0.0	2.8	13.3	4.1	7.1	17.1
13	2.9	0.0	5.6	5.9	14.3	27.0
14	3.6	7.9	10.7	7.7	14.3	12.1
15	0.0	1.8	13.9	5.1	10.7	14.3
16	10.5	12.5	15.4	13.0	17.9	22.5
17	6.3	2.4	11.4	5.8	11.8	10.9
18	4.5	3.6	9.5	7.7	16.7	16.7
19	4.3	4.2	8.5	11.5	8.7	6.9
20	13.6	6.9	9.1	6.4	6.3	3.7
21	0.0	0.0	0.0	0.0	0.0	17.6
22	3.4	1.5	10.9	5.3	10.5	13.5
23	0.0	3.7	22.7	1.7	5.0	14.6
24	9.7	10.2	10.7	7.5	4.5	6.5
25	0.0	3.1	2.6	14.3	3.0	6.8

PERCENTAGE OF TERMS MATCHED: PATENT OFFICE CLASSIFICATION MANUAL

Patent No.	Indexers 1 - 2		Indexers 1 - 3		Indexers 2 - 3	
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
1	30.6	30.6	47.7	25.0	40.0	31.3
2	44.7	40.4	38.5	37.7	53.6	44.7
3	20.0	27.4	36.8	37.6	25.0	38.5
4	40.0	34.3	42.3	36.4	31.7	61.5
5	55.6	31.2	47.5	47.9	69.4	37.0
6	40.0	10.7	37.5	20.7	22.2	28.0
7	44.4	43.2	44.8	36.6	65.0	53.6
8	47.4	38.1	50.0	40.9	22.2	52.9
9	42.9	40.0	57.9	34.4	36.8	38.7
10	35.7	33.3	37.5	35.7	26.3	55.9
11	62.5	17.4	40.0	11.1	70.0	26.2
12	39.3	24.4	53.8	33.3	65.0	42.4
13	30.4	16.7	28.0	25.0	36.4	29.0
14	33.3	13.6	14.3	17.3	13.0	26.2
15	61.5	48.1	41.7	25.9	50.0	40.7
16	34.5	48.7	46.7	47.6	72.2	54.5
17	33.3	28.3	28.1	28.8	59.1	26.4
18	33.3	39.5	13.3	31.7	53.3	61.8
19	28.9	26.0	40.0	34.9	32.3	40.9
20	17.6	12.0	35.3	28.0	41.7	36.8
21	47.8	41.2	43.5	32.4	40.9	36.4
22	55.6	18.8	11.5	20.7	37.5	31.2
23	17.1	27.7	36.4	37.8	33.3	35.1
24	29.4	25.9	41.7	32.1	62.5	45.1
25	26.1	26.9	31.8	30.8	85.7	65.0

PERCENTAGE OF TERMS MATCHED: PATENT OFFICE CLASSIFICATION MANUAL

Patent No.	Indexers 1 - 2		Indexers 1 - 3		Indexers 2 - 3	
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
1	30.6	30.6	47.7	25.0	40.0	31.3
2	44.7	40.4	38.5	37.7	53.6	44.7
3	20.0	27.4	36.8	37.6	25.0	38.5
4	40.0	34.3	42.3	36.4	31.7	61.5
5	55.6	31.2	47.5	47.9	69.4	37.0
6	40.0	10.7	37.5	20.7	22.2	28.0
7	44.4	43.2	44.8	36.6	65.0	53.6
8	47.4	38.1	50.0	40.9	22.2	52.9
9	42.9	40.0	57.9	34.4	36.8	38.7
10	35.7	33.3	37.5	35.7	26.3	55.9
11	62.5	17.4	40.0	11.1	70.0	26.2
12	39.3	24.4	53.8	33.3	65.0	42.4
13	30.4	16.7	28.0	25.0	36.4	29.0
14	33.3	13.6	14.3	17.3	13.0	26.2
15	61.5	48.1	41.7	25.9	50.0	40.7
16	34.5	48.7	46.7	47.6	72.2	54.5
17	33.3	28.3	28.1	28.8	59.1	26.4
18	33.3	39.5	13.3	31.7	53.3	61.8
19	28.9	26.0	40.0	34.9	32.3	40.9
20	17.6	12.0	35.3	28.0	41.7	36.8
21	47.8	41.2	43.5	32.4	40.9	36.4
22	55.6	18.8	11.5	20.7	37.5	31.2
23	17.1	27.7	36.4	37.8	33.3	35.1
24	29.4	25.9	41.7	32.1	62.5	45.1
25	26.1	26.9	31.8	30.8	85.7	65.0

PERCENTAGE OF TERMS MATCHED: VOCABULARY

Patent No.	Indexers 1 - 2		Indexers 1 - 3		Indexers 2 - 3	
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
1	45.7	32.0	48.6	36.6	60.0	49.0
2	18.2	28.3	40.0	43.2	19.0	31.9
3	22.0	26.3	44.4	39.1	43.4	23.8
4	41.2	42.8	52.6	41.1	51.7	45.4
5	61.5	45.4	57.1	18.7	54.5	24.5
6	30.6	33.9	39.6	42.8	50.0	43.1
7	34.9	25.9	46.8	48.3	37.8	19.4
8	12.8	24.0	32.6	27.3	25.0	40.0
9	31.0	29.7	45.2	31.3	50.0	28.3
10	30.8	27.7	26.7	29.5	63.6	48.1
11	27.8	45.5	38.9	51.5	45.5	54.8
12	51.5	42.9	68.8	45.6	75.0	47.1
13	50.0	33.3	31.4	25.0	37.0	36.4
14	28.1	20.9	42.4	26.4	44.0	36.7
15	22.9	22.0	25.0	23.3	55.0	48.0
16	38.5	20.0	26.9	32.0	54.5	35.3
17	33.3	22.9	55.6	51.2	48.4	35.9
18	41.4	43.6	62.5	48.0	43.5	33.3
19	17.9	22.0	22.7	24.5	50.0	51.2
20	18.9	28.0	73.9	40.8	25.0	41.9
21	11.1	23.1	26.9	34.5	25.0	44.4
22	42.9	30.0	54.5	37.1	50.0	40.0
23	19.3	38.5	54.8	33.9	60.0	51.1
24	50.0	15.2	33.3	19.1	57.1	42.5
25	44.0	39.1	43.8	35.5	46.9	39.7

APPENDIX II

STATISTICAL ANALYSES

ANALYSIS OF VARIANCE OF NUMBER OF TERMS USED: BASE ZERO

Item	Sums of Squares	df	MSE	Significant?
Indexer	775.8534	2	387.9267	Yes
Section	4,559.5267	1	4,559.5267	Yes
Patent	3,117.24	24	132.3850	Yes
Indexer/Section	24.0933	2	12.0466	No
Indexer/Patent	695.48	48	14.4891	No
Section/Patent	1,408.9733	24	58.7072	Yes
Residual	2,545.9067	48	53.0397	
Total	13,187.0734	149	. .	. .

ANALYSIS OF VARIANCE OF NUMBER OF TERMS USED: THESAURUS

Item	Sums of Squares	df	MSE	Significant?
Indexer	2,560.57	2	1,280.29	No
Section	3,037.50	1	3,037.50	Yes
Patent	13,404.22	24	558.51	Yes
Indexer/Section	349.72	2	174.86	Yes
Indexer/Patent	1,709.10	48	35.61	Yes
Section/Patent	1,905.00	24	79.38	Yes
Residual	811.28	48	16.90	.
Total	23,777.39	149	. .	. .

ANALYSIS OF VARIANCE OF NUMBER OF TERMS USED:
PATENT OFFICE CLASSIFICATION MANUAL

Item	Sums of Squares	df	MSE	Significant?
Indexer	1,110.5734	2	555.2867	No
Section	4,637.0400	1	4,637.0400	Yes
Patent	6,502.4267	24	270.9344	No
Indexer/Section	171.64	2	85.8200	Yes
Indexer/Patent	1,526.0933	48	31.7936	No
Section/Patent	3,412.2933	24	142.1788	Yes
Residual	1,013.0267	48	21.1047	
Total	18,373.0934	149	. .	. .

ANALYSIS OF VARIANCE OF NUMBER OF TERMS USED: VOCABULARY

Item	Sums of Squares	df	MSE	Significant?
Indexer	2,846.56	2	1,423.28	No
Patent	6,209.0266	24	258.7094	No
Section	5,376.0266	1	5,376.0266	Yes
Indexer/Patent	2,539.7734	48	52.9119	Yes
Section/Patent	1,828.9734	24	76.2072	Yes
Indexer/Section	609.0134	2	304.5067	Yes
Residual	1,395.9866	48	29.083	
Total	20,805.359	149	. .	. .

ANALYSIS OF VARIANCE OF NUMBER OF TERMS USED:
BASE ZERO AND THESAURUS

Item	Sums of Squares	df	MSE	Significant?
Test Conditions (TC)	1,391.05	1	1,391.05	No
Indexers (I)	1,549.41	2	774.71	No
Sections (S)	7,520.01	1	7,520.01	No
Patents (P)	7,395.19	24	308.13	Yes
TC/I	1,787.02	2	893.51	No
TC/S	77.02	1	72.02	No
TC/P	9,168.11	24	382.00	No
I/S	152.14	2	76.07	Yes
I/P	2,053.42	48	42.77	No
S/P	1,802.99	24	75.12	No
TC/I/S	221.67	2	110.84	Yes
TC/I/P	1,679.32	48	34.99	Yes
TC/S/P	1,529.12	24	63.71	Yes
I/S/P	1,442.72	48	30.06	Yes
Residual	586.33	48	12.22	
Total	38,355.52	299	. .	. .

ANALYSIS OF VARIANCE OF NUMBER OF TERMS USED: BASE ZERO AND
PATENT OFFICE CLASSIFICATION MANUAL

Item	Sums of Squares	df	MSE	Significant?
Test Conditions (TC)	596.4300	1	596.43	No
Indexers (I)	1,349.8867	2	674.9433	No
Sections (S)	9,196.4033	1	9,196.4033	Yes
Patents (P)	4,736.18	24	197.3408	No
TC/I	536.54	2	268.2700	No
TC/S	0.1634	1	0.1634	No
TC/P	4,943.4867	24	205.9786	Yes
I/S	57.7267	2	28.8633	No
I/P	2,161.28	48	45.0266	No
S/P	2,745.8467	24	114.4102	No
TC/I/S	277.8066	2	138.9033	Yes
TC/I/P	60.2933	48	1.2561	No
TC/S/P	2,075.4199	24	86.4758	Yes
I/S/P	1,214.7733	48	25.3077	No
Residual	2,204.3601	48	45.9241	
Total	32,156.5967	299	. .	. .

ANALYSIS OF VARIANCE OF NUMBER OF TERMS USED:
BASE ZERO AND VOCABULARY

Item	Sums of Squares	df	MSE	Significant?
Test Conditions (TC)	3,027.3633	1	3,027.3633	No
Indexers (I)	2,517.8067	2	1,258.9033	No
Sections (S)	9,918.7500	1	9,918.7500	Yes
Patents (P)	3,691.8800	24	153.8283	No
TC/I	1,104.6067	2	552.3033	No
TC/S	16.8034	1	16.8034	No
TC/P	5,694.3867	24	237.2661	No
I/S	215.4200	2	107.7100	No
I/P	1,882.86	48	39.2262	No
S/P	2,262.3333	24	94.2638	Yes
TC/I/S	417.6866	2	208.8433	Yes
TC/I/P	1,352.3933	48	28.1748	No
TC/S/P	1,058.9466	24	44.1227	No
I/S/P	1,709.2467	48	35.6093	No
Residual	2,149.3134	48	44.7773	
Total	37,019.7967	299	. .	. .

ANALYSIS OF VARIANCE OF NUMBER OF TERMS USED: THESAURUS,
PATENT OFFICE CLASSIFICATION MANUAL, AND VOCABULARY

Item	Sums of Squares	df	MSE	Significant?
Test Conditions (TC)	944.1733	2	472.0866	No
Indexers (I)	5,876.92	2	2,938.4600	No
Sections (S)	12,874.7755	1	12,874.7755	Yes
Patents (P)	9,044.6311	24	376.8596	No
TC/I	640.7867	4	160.1966	Yes
TC/S	175.7912	2	87.8956	No
TC/P	17,071.0489	48	355.6468	Yes
I/S	1,040.1378	2	520.0689	Yes
I/P	2,008.3022	48	41.8396	No
S/P	2,203.5022	24	91.8125	No
TC/I/S	90.2355	4	22.5588	No
TC/I/P	3,766.6578	96	39.2360	Yes
TC/S/P	4,942.7644	48	102.9742	Yes
I/S/P	792.4178	48	16.5087	No
Residual	2,427.8756	96	25.2903	
Total	63,900.0200	449	. .	. .

ANALYSIS OF VARIANCE OF PERCENTAGE OF TERMS MATCHED: BASE ZERO

Item	Sums of Squares	df	MSE	Significant?
Indexer	2,238.9762	2	1,119.4881	No
Section	22.3494	1	22.3494	No
Patent	958.5900	24	39.9412	No
Indexer/Section	722.8468	2	361.4234	Yes
Indexer/Patent	3,648.4172	48	76.0086	Yes
Section/Patent	720.8690	24	30.0362	No
Residual	2,821.0998	48	58.7708	
Total	11,132.2484	149	. .	. .

ANALYSIS OF VARIANCE OF PERCENTAGE OF TERMS MATCHED: THESAURUS

Item	Sums of Squares	df	MSE	Significant?
Indexer Pairs	1,191.24	2	595.62	No
Section	2.44	1	2.44	No
Patent	1,024.43	24	42.68	Yes
Indexers/Section	158.36	2	79.18	Yes
Indexers/Patent	2,277.09	48	447.44	Yes
Section/Patent	265.71	24	11.07	No
Residual	1,362.34	48	28.38	
Total	6,281.61	149	. .	. .

ANALYSIS OF VARIANCE OF PERCENTAGE OF TERMS MATCHED:
PATENT OFFICE CLASSIFICATION MANUAL

Item	Sums of Squares	df	MSE	Significant?
Indexer	2,940.5488	2	1,470.2744	Yes
Section	1,467.0320	1	1,467.0320	Yes
Patent	8,573.1276	24	357.2136	No
Indexer/Section	104.4486	2	52.2243	No
Indexer/Patent	6,950.5012	48	144.8021	Yes
Section/Patent	4,186.7596	24	174.4483	Yes
Residual	4,051.8748	48	84.4140	
Total	28,274.2916	149	. .	. .

ANALYSIS OF VARIANCE OF PERCENTAGE OF TERMS MATCHED: VOCABULARY

Item	Sums of Squares	df	MSE	Significant?
Indexer Pairs	3,445.7942	2	1,722.8971	Yes
Section	1,362.6294	1	1,362.6294	Yes
Patent	6,275.2118	24	261.4671	No
Indexers/Section	237.3424	2	118.6712	No
Indexers/Patent	6,833.8958	48	142.3728	Yes
Section/Patent	3,542.2789	24	147.5949	Yes
Residual	2,662.7343	48	55.4736	
Total	24,359.8868	149	. .	. .

ANALYSIS OF VARIANCE OF PERCENTAGE OF TERMS MATCHED:
BASE ZERO AND THESAURUS

Item	Sums of Squares	df	MSE	Significant?
Test Conditions (TC)	53.43	1	53.43	No
Indexers (I)	3,297.11	2	1,698.56	No
Sections (S)	5.02	1	5.02	No
Patents (P)	1,234.11	24	51.44	No
TC/I	131.10	2	65.55	No
TC/S	19.76	1	19.76	No
TC/P	748.90	24	31.20	No
I/S	703.72	2	351.86	Yes
I/P	3,212.96	48	66.94	Yes
S/P	531.22	24	22.13	No
TC/I/S	179.50	2	89.75	No
TC/I/P	2,725.83	48	56.79	No
TC/S/P	455.37	24	18.97	No
I/S/P	1,611.59	48	33.57	No
Residual	2,557.66	48	53.28	
Total	17,467.28	299	. .	. .

ANALYSIS OF VARIANCE OF PERCENTAGE OF TERMS MATCHED:
BASE ZERO AND PATENT OFFICE CLASSIFICATION MANUAL

Item	Sums of Squares	df	MSE	Significant?
Test Conditions (TC)	60,055.4305	1	60,055.4305	Yes
Indexers (I)	4,862.1921	2	2,431.0960	Yes
Sections (S)	925.7633	1	925.7633	No
Patents (P)	5,192.0465	24	216.3352	No
TC/I	317.3329	2	158.6664	No
TC/S	563.6182	1	563.6182	Yes
TC/P	4,339.6711	24	180.8196	No
I/S	390.7521	2	195.3760	No
I/P	5,105.1979	48	106.3582	No
S/P	1,844.6883	24	76.8620	No
TC/I/S	436.5432	2	218.2716	No
TC/I/P	5,493.7205	48	114.4525	Yes
TC/S/P	3,062.9402	24	127.6225	Yes
I/S/P	3,589.9413	48	74.7904	No
Residual	3,282.1334	48	68.3777	
Total	99,461.9715	299	. .	. .

ANALYSIS OF VARIANCE OF PERCENTAGE OF TERMS MATCHED:
BASE ZERO AND VOCABULARY

Item	Sums of Squares	df	MSE	Significant?
Test Conditions (TC)	63,388.5888	1	63,388.5888	Yes
Indexers (I)	5,578.3553	2	2,789.1776	No
Sections (S)	867.0000	1	867.000	No
Patents (P)	3,308.1372	24	137.8390	No
TC/I	106.4150	2	53.2075	No
TC/S	517.9788	1	517.9788	Yes
TC/P	3,925.6645	24	163.5693	No
I/S	775.0854	2	387.5427	Yes
I/P	5,398.9714	48	112.4785	No
S/P	1,647.6400	24	68.6516	No
TC/I/S	185.1038	2	92.5519	No
TC/I/P	5,083.3417	48	105.9029	Yes
TC/S/P	2,615.5079	24	108.9794	Yes
I/S/P	2,469.4046	48	51.4459	No
Residual	3,013.5295	48	62.7818	
Total	98,880.7239	299	. .	. .

ANALYSIS OF VARIANCE OF PERCENTAGE OF TERMS MATCHED: THESAURUS,
PATENT OFFICE CLASSIFICATION MANUAL, AND VOCABULARY

Item	Sums of Squares	df	MSE	Significant?
Test Conditions (TC)	87,239.2237	2	43,619.6118	Yes
Indexers (I)	6,480.2857	2	3,240.1428	Yes
Sections (S)	1,808.4098	1	1,808.4098	No
Patents (P)	5,500.1673	24	229.1736	No
TC/I	1,097.2932	4	274.3233	No
TC/S	1,023.6875	2	511.8437	Yes
TC/P	10,372.5980	48	216.0957	No
I/S	149.7681	2	74.8840	No
I/P	3,730.0010	48	77.7083	No
S/P	1,910.0367	24	79.5848	No
TC/I/S	350.3882	4	87.5970	No
TC/I/P	12,291.4951	96	128.0364	Yes
TC/S/P	6,084.8400	48	126.7675	Yes
I/S/P	3,286.0604	48	68.4595	No
Residual	4,830.7543	96	50.3203	
Total	146,155.0090	449	. .	. .

APPENDIX III

INDEXING INSTRUCTIONS, AF30(602)-2616, PHASE II

1. Phase II Tests are designed to measure the consistency of term assignment among indexers using various indexing aids. During the tests, the indexers should not communicate with each other regarding the indexing of any document.
2. The first test (of three scheduled) will utilize the Documentation Incorporated Chemical Patents Coding Manual.
3. Each indexer will index a total of 50 chemical patents according to the familiar rules of coordinate indexing, and will record freely assigned terms on the tracing card. Simultaneously, or subsequently, the indexer will consult the indexing tools for each term on the tracing card.
4. The Indexing tool is to be used as an aid, i.e., indexers are free to adopt or reject any of the terms contained in the Manual. They will indicate, next to each term on the tracing card, one of the following alternatives:
 - (a) Original term, also found in the aid, was retained;
 - (b) Original term, not found in the aid, was retained;
 - (c) Original term was rejected upon inspection of the aid (irrespective of whether the term was found in the aid), and no new term selected;
 - (d) Term adopted from the aid instead of a term assigned originally;
 - (e) Additional term adopted from the aid.
5. The title and all claims of each patent must be indexed. The remainder of the patent should be indexed according to the judgment of each indexer of what is appropriate to describe the document.